

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF INDIANA DEPARTMENT OF
GEOLOGY, EDWARD BARRETT, STATE GEOLOGIST.

SOIL SURVEY OF WELLS COUNTY, INDIANA.

BY

W. E. THARP, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN
CHARGE, AND W. E. WILEY, OF THE INDIANA
DEPARTMENT OF GEOLOGY.

W. E. MCLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]



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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,

Washington, D. C. April 10, 1916.

SIR: In the extension of the soil survey in the State of Indiana work was undertaken in Wells County and completed during the field season of 1915. This work was done in cooperation with the State of Indiana, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Wells County sheet, Indiana.

SOIL SURVEY OF WELLS COUNTY, INDIANA.

By **W. E. THARP**, of the U. S. Department of Agriculture, in charge, and
W. E. WILEY, of the Indiana Department of Geology.—Area inspected by
W. E. McLENDON.

DESCRIPTION OF THE AREA.

Wells County is situated in the northeastern part of Indiana. It is bounded on the north by Allen County, on the east by Adams County, on the south by Jay and Blackford, and on the west by Grant and Huntington Counties. Its length from north to south is 24 miles and its width is 14 miles, except in the extreme southern part, where it is 20 miles. The county embraces an area of 365 square miles, or 233,600 acres.

The greater part of the surface is a somewhat uneven plain having an elevation of about 850 feet above sea level. Throughout the northeastern, west-central, and south-central parts of the county the topography varies from nearly level to gently undulating. Except in the immediate vicinity of the larger streams that cross these areas, the differences in local elevation do not usually exceed 10 or 15 feet. The slopes are more pronounced along the lower courses of these streams, and become somewhat shorter and steeper as the rivers are approached, but in very few places are they so steep as to hinder the use of farm machinery.

In Jackson Township, which is the southwestern projection of the county, the surface features generally conform to the above description, except for a mile or more on each side of the Salamonie River. Here much of the upland is strongly rolling and there are numerous blufflike slopes of 50 to 75 feet overlooking the narrow valley of the stream. The most marked development of such topography is found just below the mouth of Prairie Creek on the west side of the valley, where the margin of the upland is broken into steep ridges of unequal height.

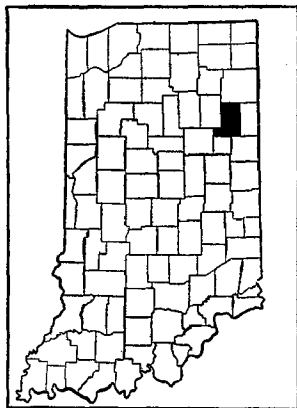


FIG. 1.—Sketch map showing location of the Wells County area, Indiana.

A belt of relatively hilly land extends from the Wabash River at Bluffton northward to Ossian, and thence in a northwesterly direction to the corner of the county. It averages about 3 miles in width, and although locally termed a ridge, is not very much higher than the country to the east, though noticeably higher than that on the west and south. The highest points rise about 100 feet above the Wabash Valley. The surface in general is undulating to strongly rolling, with the irregular "bumpy" contours characteristic of morainic topography.

A similar morainic ridge is found in the extreme southern part of the county, embracing most of the two southern tiers of sections, from the southeast corner to the Salamonie Valley, and extending thence along the north side of that stream into Jackson Township.

Excepting the narrow valleys of the streams, practically all the topographic features are morainic rather than erosional.

The Wabash River crosses the middle of the county in a northwesterly direction and the Salamonie River has a similar course through the southwestern part. Their valleys are narrow and comparatively shallow, being nowhere more than 100 feet below the highest points of the adjacent upland. While the general course of the rivers and larger creeks is from southeast to northwest, much of the minor drainage is from southwest to northeast. This feature is observable in the trend of many of the low ridges and slight depressions. Practically none of the surface is untillable, except the steep slopes that bound the stream valleys and a few very small areas of Muck.

The rivers and creeks are perennial streams, and many of the larger ditches are fed by so many tile drains that they are dry only during periods of exceptionally light rainfall. Most farm wells are sunk through the till into the limestone, and an unfailing supply of excellent water is obtained. Few of them are more than 150 feet deep.

The first settlement in Wells County was made in Lancaster Township in 1829, but it was not until the late thirties that any considerable number of settlers had located within the county. In 1910, according to the census, the population of the county was 22,418, of which 77.8 per cent was classed as rural. The density of the rural population was about 48 persons per square mile. The population of Bluffton, the county seat, was 4,987, and that of Ossian, the next largest town, was 661. Other towns of local importance are Keystone, Poneto, Vera Cruz, Markle, and Uniondale. The negro population and the foreign-born population of the county are small.

The Erie and the Toledo, St. Louis & Western Railroads cross the county east and west, and the Lake Erie & Western Railroad north and south. A line between Portland and Huntington (the Cincin-

nati, Bluffton & Chicago Railroad) also crosses the county from northwest to southeast. Two electric railways centering at Bluffton afford almost hourly service between that point and Fort Wayne, Marion, and other towns in this section of the State. There is also an electric line from Bluffton to Geneva.

The public roads are well graded and surfaced with stone or gravel. Almost every farmhouse has telephone and rural-delivery service.

CLIMATE.

The climate of Wells County, in common with that of all of northern Indiana, is comparatively uniform. The mean annual temperature, as recorded at the Weather Bureau station at Bluffton, is 50° F. The mean for the winter months is 25.8°; for the spring months, 50.0°; for the summer months, 71.1°; and for the fall months, 53.2°. The highest recorded temperature is 103° in July and the lowest -23° in January.

The mean annual precipitation is 36.94 inches, of which 10.88 inches falls during the spring months, and 11.70 inches during the summer months. This is sufficient to insure good yields of corn, alfalfa, clover, and grasses where proper cultural methods are followed, but any marked deficiency in rainfall during the summer months affects the crops very materially. The average depth of snowfall is 23.5 inches.

The average date of the last killing frost in the spring is May 7 and of the first in the fall October 2, giving a normal growing season of 148 days. The latest recorded date of a killing frost in the spring is May 31 and the earliest in the fall is September 19.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation at Bluffton:

Normal monthly, seasonal, and annual temperature and precipitation at Bluffton.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1896).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	26.9	62	- 12	2.49	4.01	1.82	5.0
January.....	26.5	70	- 23	2.33	1.17	1.31	5.5
February.....	24.1	66	- 19	2.08	.93	1.52	6.2
Winter.....	25.8	70	- 23	6.90	6.11	4.65	16.7
March.....	38.8	82	- 3	4.08	2.76	3.42	4.4
April.....	49.6	92	17	2.97	2.34	5.29	.9
May.....	61.6	93	24	3.83	4.16	5.63	0
Spring.....	50.0	93	- 3	10.88	9.26	14.34	5.3

Normal monthly, seasonal, and annual temperature, etc.—Continued.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1896).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
June.....	68.2	99	37	4.25	3.29	4.66	0
July.....	73.3	103	42	3.93	1.23	6.53	0
August.....	71.9	98	42	3.52	4.79	7.85	0
Summer.....	71.1	103	37	11.70	9.31	19.04	0
September.....	66.2	100	28	2.40	1.12	5.04	0
October.....	53.2	94	17	2.18	3.40	1.04	T.
November.....	40.3	74	10	2.88	1.50	2.31	1.5
Fall.....	53.2	100	10	7.46	6.02	8.39	1.5
Year.....	50.0	103	— 23	36.94	30.70	46.42	23.5

AGRICULTURE.

Practically all the county was originally heavily forested and the removal of the timber and the drainage of the innumerable swampy tracts progressed rather slowly at first. In later years, however, through cooperative efforts in the construction of the larger ditches and the straightening of many small streams, the improvement of drainage was more rapid and effectual. With the exception of a very few small depressions, all the former poorly drained lands are now tillable. The remnants of the original forest consist of groups of trees around farm buildings, small woodland pastures, and occasional blocks of 10 to 20 acres of comparatively heavy timber. Perhaps 10 per cent of the total area has escaped the plow.

Corn, wheat, and oats are the principal crops, ranking in the order named. In 1909, 57,242 acres were devoted to corn, producing 2,407,119 bushels.¹ In 1899 51,833 acres gave approximately the same returns, while in 1889, 42,421 acres produced 1,271,516 bushels. According to census returns, as well as the testimony of many of the older farmers, the average yield per acre is higher than it was 30 or 40 years ago. Better methods of tillage and the reclamation of many hundreds of acres of the Clyde soils (black lands) are the chief factors in this increase.

For each of the three census years 1879, 1889, and 1899, approximately 25,000 acres were sown to winter wheat, and the average yields were about 14 bushels per acre. In 1909 the acreage dropped to 9,872 and the production was 137,956 bushels, or 14 bushels per

¹ Agricultural data given in this chapter are taken from the census reports.

acre. While the usual acreage in recent years is undoubtedly above that just given, it would be greatly reduced were it not that many farmers prefer wheat to oats in the usual rotation of corn, wheat or oats, and clover. Few farmers consider the crop profitable unless returns of 20 to 30 bushels per acre are obtained.

The area in oats in 1909 was 33,961 acres, as compared with 16,928 acres in 1899 and 12,663 acres in 1889. The average yield for each of these years was very close to 35 bushels per acre, but the returns vary greatly from year to year and from farm to farm, ranging from less than 20 bushels per acre on some farms to as high as 80 or 90 bushels on others.

The value of clover for soil improvement is generally recognized, and more or less of it is grown on practically every farm. As a rule clover and timothy are grown together, and a clear stand of either is usually the result of one or the other failing to "catch," or to maintain itself during the period when the land is used as pasture or mowing land.

Within the last 5 years the total acreage of alfalfa has rapidly increased, and the experimental stage of its introduction may be said to have been passed. On many farms there are fields of 3 to 5 acres, and in a few instances farmers have extended such small beginnings to 20 or 30 acres. Three cuttings per annum are generally made, with an average yield in most cases of about 1 ton per acre at each cutting.

The culture of soy beans has been taken up by many farmers within the last few years. Several hundred acres were planted in 1915, mostly in small acreages, although there were a few fields of 10 to 20 acres each. Various cultural methods are followed. In some instances the seed is drilled in rows 10 or 15 inches apart, and some cultivation is given during the early period of growth. In many fields the seed is sown broadcast on well-prepared ground and no cultivation is given, and occasionally the seed is planted in corn at the last cultivation. Good results have attended each of the first two methods, and returns of 30 bushels per acre have been reported. In the wet season of 1915 cultivated fields gave more satisfactory results. The crop is harvested with a mower, provided with a bunching attachment, and on becoming sufficiently dry is run through a thrashing machine.

For several years past some attention has been given to the growing of sugar beets. In 1915 more than 200 acres were planted, chiefly in fields ranging from 5 to 20 acres each, but on about 40 acres the crop was destroyed by the exceptionally wet weather, which caused water to stand for days at a time on some of the lowest ground. The acreage harvested yielded about 12.5 tons per acre. The beets are grown under contract with a sugar-manufacturing company, one of

whose plants is located at Decatur, Ind. The company provides seed, implements, and laborers, who do the hand weeding and thinning, charging so much per acre for that service. The grower prepares the ground, cultivates the crop, and delivers it to the shipping point on the railway. The cost of production varies considerably, but a conservative estimate would be about \$25 per acre, exclusive of the grower's work and rent of land. The contract price in recent years has been about \$5 per ton, with a provisional increase if sugar goes above a certain price within four months after the beets are harvested. Many growers obtained yields of 16 to 18 tons per acre in 1915. The Clyde silty clay loam is preferred for the crop, for the sugar content of beets grown on it is as high as in beets grown on the Miami soils, while the tonnage is usually considerably greater.

Very little attention is given to truck growing. Potatoes are grown for the local market, and in some seasons tomatoes are produced under contract with canning companies outside the county.

Nearly every farm has a small apple orchard, in addition to many pear, plum, and cherry trees, but there are only two or three commercial orchards in the county.

Wheat and sugar beets are almost the only strictly sale crops. Oats are in part a sale crop, although much of this grain is retained on the farms for feed. By far the larger part of the corn crop is also fed on the farm where produced or sold to neighboring farmers.

On nearly all farms the sale of hogs constitutes the largest single source of income. The raising of beef cattle is not very important and only a few farmers make a practice of feeding steers. Dairying is confined chiefly to the production of milk and cream for shipment outside the county, or for sale to a milk condenser located at Vera Cruz. There are some large, well-kept dairy farms in the county and many of the farmers near the railroads and electric lines keep a few dairy cows. There are no cooperative creameries. There are a good many small flocks of sheep, but no large flocks are kept on any farms, nor are any sheep imported to be fattened. Poultry constitutes an important source of income.

The great importance of hog raising in the agriculture of the county is shown in the United States census reports. In 1909 there were 65,342 hogs sold or slaughtered, or an average of about 36 head to the farm. In that year also 2,586 calves, 4,881 other cattle, and 9,619 sheep and goats were sold or slaughtered, and there were 7,949 dairy cows on farms reporting dairy products. The total value of animals sold and slaughtered was \$1,276,219; of dairy products, excluding home use of milk and cream, \$171,184; and of poultry and eggs produced, \$387,881.

The adaptation of soils to crops is generally recognized in Wells County. The Clyde silty clay loam is considered especially well

suited to corn, while the Miami silty clay loam and the Fox loam are considered somewhat better wheat lands than either the Clyde or the Crosby silty clay loam. Practically all cereals, grasses, and vegetables make larger average yields on the black than on the gray soils, but as a rule the crops produced on the latter are of better quality. In the case of potatoes, tomatoes, and some other vegetables the difference is quite marked. It is also noticeable in the case of timothy hay and in the pasturage value of clover and grass. With respect to wheat and oats, the soil does not seem to influence the quality to any appreciable degree, except indirectly as the soil types respond differently to seasonal influences. The Miami soils, under good management, produce firm, well-matured corn of very high feeding value, while on the Clyde soils this crop tends to late maturity and is somewhat lower in feeding value. The difference is most noticeable in grain grown on phases of the Clyde silty clay loam that approach Muck or have an exceptionally high content of organic matter. Apple, cherry, and pear trees thrive on the Miami soils, but seem to have shorter life on the Clyde, even in areas that are well drained.

Labor-saving machinery is in general use. It is probable that the equipment on the average farm includes as many of the latest types of agricultural implements as can be found anywhere in the corn belt. Nearly all tillage operations are performed with riding implements and hand labor everywhere is reduced to a minimum. Heavy horses are generally used and but few mules are employed. Very recently several gasoline tractors have been introduced, which have been satisfactorily used for plowing. Numerous steam traction engines are employed for thrashing, hulling clover, and sawing wood.

Corn ground is usually plowed 5 or 6 inches deep, disked or harrowed once or twice, and the corn planted in "checks" so as to admit of cross-cultivation. Many farmers, however, prefer drilling the seed so as to have single stalks about a foot apart in the rows, a method that is quite satisfactory if the ground is free from weeds. Shallow cultivation is the rule, but the crop is "laid by" after three or four cultivations. Fall plowing is not so generally practiced as would seem desirable, owing in part to the tendency of the Miami soils to "run together" if much wet weather prevails, and also to the utilization of the second-growth clover for winter pasturage where this precedes the cultivated crop. Commercial fertilizer is rarely applied to corn ground. It is more frequently used on wheat land, although the practice is not so common as in some of the counties farther west in the State.

Only winter varieties of wheat are grown. Some of the seed is drilled in corn fields, either between the rows or after the corn has been cut for fodder or ensilage. In the latter case the ground is usually disked, but in the former no preparation is practicable.

While the type of soil, its condition at seeding time, and the subsequent seasonal conditions are the chief factors in determining yields, grain sown on ground that has been plowed rather early in the season and disked or harrowed until a suitable seed bed is prepared usually gives the best returns. On adjoining lands in recent years the yields have varied from 15 to 30 bushels per acre.

Oats are almost invariably sown on land that was in corn the preceding year, the seed being drilled among the stalks. Such disk-ing and harrowing as is done is less effective than if the ground were in better condition than is usually the case in early spring. Beyond doubt, the land used for this crop is less thoroughly prepared than for any of the other important crops. Owing partly to this and partly to the high moisture requirement of oats the yields are greatly affected by irregularities in precipitation during the spring and early summer.

A steadily increasing proportion of the farmers whose lands consist largely of the Miami and Crosby types are using commercial fertilizers. In most instances mixtures containing about 1 or 2 per cent nitrogen, 6 to 10 per cent phosphoric acid, and 3 or 4 per cent potash are applied at the rate of 200 pounds per acre. While varying results have been obtained, the opinion is general that yields are increased and the quality of grain is somewhat improved by the use of commercial fertilizer. In a few instances commercial fertilizers have been applied to corn land, usually the Miami and Crosby silty clay loams, but no very definite results have been obtained. The growing of clover as a green manuring crop is preferred, and recently the use of soy beans has been receiving attention. Lime as a soil amendment is used to some extent, chiefly in an experimental way by a few farmers desirous of insuring a stand of alfalfa or an increased yield of clover. No raw rock phosphate or basic slag has been used.

As previously stated, the most common rotation consists of corn, followed by wheat or oats with which clover and timothy have been sowed—the latter crops usually occupying the land two years. Many farmers would eliminate the small grain entirely if a practicable method of changing land from corn to grass could be found. In the wet season of 1915 clover sown in cornfields in August or September made a good stand, and this method, where late tillage is practiced, promises to be generally successful.

A very large proportion of the farms are well improved. The houses are commodious and comfortable and the barns and buildings afford ample room and convenient means for the care of crops and live stock. Some of the smaller farms, particularly those occupied by tenants, are not so well improved, but nearly all are well fenced. In the extreme southern part of the county, which lies in

the oil and gas belt, agriculture has been somewhat neglected during the last 20 years, and on many of the farms the improvements are comparatively poor.

Wages for farm hands range from \$25 to \$30 per month with board. During harvest a daily wage of \$1.50 to \$2 is paid. No marked scarcity of labor in recent years is reported.

Both the cash and share systems of rental are in use in the county. Well-improved farms consisting chiefly of the Clyde silty clay loam rent for \$6 to \$8 an acre per annum, or for two-fifths to one-half of the grain crops, with a cash consideration for mowing and pasture lands. Many farms are operated on the basis of equal shares, and this plan is increasing in favor. In 1880, 80 per cent of the farms were operated by the owners; in 1910 the percentage had declined to 67.4.

In 1910 there were 2,655 farms in the county, as compared with 2,884 in 1900, showing a decrease of 229 in 10 years. One thousand and eighty-one farms range in size from 50 to 99 acres, 675 include from 100 to 174 acres, and about 500 have from 20 to 49 acres. The respective groups represent for the most part holdings of 80, 160, and 40 acres. Only 4 farms include more than 500 acres each. The average size of farms is 85.2 acres.

Farm land within a few miles of large towns or near the electric railways sells for \$150 to \$200 an acre, while more inaccessible land is valued at \$100 to \$150 an acre. Well-improved farms consisting chiefly of "black" land command the highest prices.

SOILS.

The surface formation throughout this county is a glacial deposit of the period known as the late Wisconsin ice invasion. As exposed in road cuts this material is a light-brown to pale yellowish brown till, composed chiefly of silt and clay, with only a small proportion of sand, and as a rule comparatively few pebbles and stones. It is therefore quite compact and has a decided tendency to a granular structure below the immediate surface layer, which is very silty and friable. The stony material includes much chert, quartz, fine-grained granite, and other resistant rocks, but there are also some rather soft shale fragments and much limestone. Below 20 to 30 inches the till is highly calcareous.

On the slopes bordering the river valleys and throughout most of the depressions in which the larger creeks flow the clayey till gives place to beds of irregularly stratified sand and gravel. There are usually several feet of silty material overlying these deposits, so that there are very few surface exposures of the gravel, except on the steeper slopes. Like the till, this gravel is very calcareous.

Both the heavy till of the uplands and the gravelly deposits of the lower lands usually change at a depth of a few yards to a lighter colored and more compact glacial material. The latter is not so permeable as the overlying strata and probably affects their drainage to some extent. This substratum also contains much lime.

The glacial deposits rest upon Niagara limestone. On the uplands the depth from the surface to this rock varies from 15 or 20 to upward of 100 feet. In the Wabash Valley and on the lower courses of some of the southern tributaries of that stream the rock occurs at slight depths, and in a few places may be touched by the plow. Otherwise it exerts no direct influence upon the soils.

The leaching and oxidation of the surface layers of the till, the feeble erosion that the mild topography induces, combined with the effect of the original vegetal covering, has given rise to several distinct soil series.

In the depressions or wherever the natural drainage is sluggish black soils with drab subsurface and light-grayish subsoils have been developed. Here the Clyde series is developed—a series of common occurrence throughout northern Indiana. Its distinctive features, the black color and granular structure, are due chiefly to the high content of organic matter. This is carbonaceous material, or the residue of vegetal matter that has decomposed under the swampy conditions that formerly prevailed in these depressed areas. While nearly all the type was forested when white men entered this region, it is highly probable that in recent times, geologically considered, each area has passed through the successive stages of pond, marsh, marshy prairie, and ill-drained forest land.

Wherever the surface has a pronounced inclination, or is even slightly convex upward and therefore has effective drainage, light-colored silty soils are found, with heavier subsoils in which shades of brown or yellowish brown prevail. The more rolling areas where good drainage prevails give rise to the Miami series of soils, except distinctly morainic areas with a porous, gravelly substratum, which belong in the Bellefontaine series, and the flatter areas with less perfect drainage, which are classed in the Crosby series. All these comparatively well drained areas were originally forested, and under such conditions organic remains do not accumulate, as in similar soils covered with herbaceous plants.

All the terraces, consisting of water-deposited material, belong in the Fox series and the first bottoms in the Genesee series. Muck and Meadow are miscellaneous types of limited development.

The Miami series is characterized by light brownish gray surface soils and yellowish-brown, heavier and more compact subsoils, distinctly calcareous below a depth of 20 to 36 inches. In the heavier members a slight mottling occurs in the upper subsoil, but this is not

so pronounced and does not extend to so great a depth as in the corresponding members of the Crosby series. The surface is undulating to rolling and there is little or no need for artificial drainage. The silty clay loam is the only member of the series developed in Wells County.

The Crosby series is developed in level to slightly undulating upland areas, generally occupying an intermediate position between the Miami and Clyde soils with respect to topography and drainage. The surface soils are light gray or light brownish gray in color, while immediately beneath there is a light ashy gray to gray and yellowish mottled layer, extending to a depth of 12 to 16 inches. The subsoils are dull yellowish brown in color, of rather heavy texture and compact structure, and distinctly calcareous below a depth of 2 feet. Artificial drainage proves beneficial in all types of the Crosby series. The series is represented by the silty clay loam, this being the most extensive of the upland soils.

The surface soils in the Bellefontaine series are grayish brown to brown and the subsoils are yellowish brown to reddish brown. The upper part of the subsoil is heavier than the soil and more compact, but at a depth of 2 to 3 feet beds of coarser material are encountered, consisting of sand, gravel, and larger stone fragments, a large proportion of which is limestone. The surface is gently undulating to very irregular morainic and the natural drainage even more thorough than in the Miami soils. In Wells County the series is represented by the loam member, which has a very small extent.

The Clyde soils, developed in the slightly depressed, poorly drained areas throughout the county, are in striking contrast to the light-colored soils of the foregoing series. The surface soils are dark brownish gray to black and the subsoils are drab or gray and yellowish mottled. All areas mapped in the county were classed as the silty clay loam.

The Fox series includes grayish-brown to brown surface soils and yellowish-brown to reddish-brown, heavier subsoils resting upon beds of calcareous sand and gravel at shallow depths, usually less than 3 feet. They are level to gently undulating in topography and naturally well drained. In appearance the Fox and Bellefontaine soils are very similar, but the former are confined to the terraces, where the material is water deposited, while the latter occur in the till upland, usually in areas of distinct morainic topography. One type, the Fox loam, is mapped.

The Genesee soils are brown to dark brown in the surface portion and somewhat lighter brown to grayish brown in the subsoils. They are level to slightly undulating in topography and have fair to good drainage, but are subject to occasional overflows. They are alluvial in origin.

The term Muck is applied to areas in which the soil to a depth of 12 inches or more is a true muck, or finely divided organic remains, dark brown to black in color.

Wet bottom-land areas, generally narrow strips along some of the small streams where the texture of the soil is extremely variable, are classed as Meadow.

The following table gives the names and the actual and relative extent of the several types mapped in Wells County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Crosby silty clay loam.....	90,816	38.9	Muck.....	1,472	0.6
Clyde silty clay loam.....	70,464	30.2	Bellefontaine loam.....	896	.4
Miami silty clay loam.....	60,096	25.7	Fox loam.....	896	.4
Genesee silt loam.....	6,592	2.8			
Meadow.....	2,368	1.0	Total.....	233,600

MIAMI SILTY CLAY LOAM.

The surface soil of the Miami silty clay loam is a gray to brownish-gray, friable, heavy silt loam, containing a small proportion of fine sand and usually a few pebbles and very small stones. At a depth of 6 to 8 inches it changes to a pale yellowish brown silty clay loam, which at a slightly greater depth grades into a rather compact, crumbly silty clay. The subsoil, beginning at 10 to 12 inches, is a yellowish-brown clay, quite compact, and with a decided tendency toward a coarsely granular structure on drying. The upper part of the subsoil usually has a pronounced brownish tint, with some brownish mottling, indicative of a higher degree of oxidation of the iron constituents than has occurred in the lower part. The latter is lighter colored, with numerous thin flakes and specks of light gray, and is usually very compact. Where there is more than the average proportion of sand, the structure throughout the 3-foot section is more open, and reddish-brown tints prevail to a greater depth. This condition is usually indicated by a pronounced brownish tint of the surface soil and the presence of some gravel and a few stones. The content of organic matter is very low, except in slight depressions or where the type merges into the Clyde soils. The soil and upper subsoil are rather thoroughly leached of lime, but the lower subsoil is sufficiently calcareous to effervesce freely when tested with hydrochloric acid. The substratum, which is usually pale yellowish brown silty clay with more or less grayish flakes, is highly calcareous, and a part of the included stony material consists of limestone fragments. There are very few large boulders and the occurrence of small ones is generally limited to knolls and to the

steeper parts of hillsides near the streams. Pebbles and small, rounded pieces of hard rocks are quite numerous in such places, but nowhere interfere with tillage operations.

This type prevails on the strongly undulating to moderately rolling areas of the uplands. The largest area is the morainic belt, extending from Vera Cruz to the northwest corner of the county. A similar ridge extends across the extreme southern part of the county and includes the long, undulating slopes north of the Salamonie River. Immediately south of the latter stream, and also of the Wabash River, the type has a rather limited development. Smaller areas occur along the larger creeks, and there are occasionally low morainic mounds remote from any stream on which the soil is essentially identical with that of the larger areas just described.

The surface drainage is good, but owing to the heavy structure of the subsoil the underdrainage is rather slow.

Excepting the small acreage remaining in timber and the steepest slopes near the streams, all the type is in cultivation. Owing to its naturally good drainage, many of the earliest clearings were made on this type and some fields have been in cultivation for 50 or 60 years. In many such instances where the surface is rolling the originally silty surface layer has been largely removed by erosion, and the compact substance thus brought above the plow line is neither so easily tilled nor so retentive of moisture as the typical surface soil. Where the content of sand in soil and subsoil is somewhat above the average the loss of some of the silty surface soil is not so apparent, for the subsurface yields more easily to tillage and its absorptive capacity lessens the liability to injury of crops during short droughts.

The Miami silty clay loam is used largely in the production of corn, oats, hay, and wheat. It is considered a good wheat soil, and yields of 30 bushels per acre are often obtained. In most instances such favorable returns are obtained by thorough preparation of the soil and rather liberal fertilization. The average yield is below 20 bushels per acre.

Oats do well in normal seasons and are less liable to lodge in wet ones than on the Clyde soils. In dry years the yield is invariably reduced on land that has been cropped several successive years or otherwise poorly managed.

The suitability of the type for corn is largely determined by the amount of organic matter in the soil. Where this important element is supplied, by applying stable manure or turning under clover, yields of 60 to 70 bushels per acre are very frequently obtained. The average yield is less than 40 bushels per acre.

As a rule little trouble is experienced in obtaining a stand of clover or timothy, especially if wheat or rye is used as the nurse crop and no exceptionally dry weather occurs in July or August. Clover generally maintains itself several years and "clover sickness" is unknown. No difficulty due to acidity is reported. The abundance of lime in the subsoil doubtless accounts for the manner in which most legumes thrive on this type.

Tomatoes and other garden vegetables do not make so heavy a growth as on the darker colored soils, but the quality of the product is good.

Many of the oldest apple orchards in the county are located on this type, and it is well suited to tree fruits of all kinds.

Commercial fertilizers are used to some extent, principally in connection with the corn and wheat crops.

The present market value of the type ranges from \$125 to \$175 an acre.

In the following table the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Miami silty clay loam are given:

Mechanical analyses of Miami silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
282204.....	Soil.....	1.0	3.9	2.3	7.6	7.4	55.2	22.2
282205.....	Subsoil.....	1.0	1.8	1.2	4.4	5.2	45.1	41.2
282206.....	Lower subsoil...	1.2	1.4	1.0	4.7	4.9	39.5	47.2

CROSBY SILTY CLAY LOAM.

The Crosby silty clay loam to a depth of 5 to 8 inches is a light-gray or light brownish gray, medium to heavy silt loam, grading into a light-gray and yellowish mottled, somewhat plastic silty clay loam. At a depth of 10 to 12 inches the subsoil becomes a yellowish-brown, plastic silty clay loam to silty clay, with some gray mottlings, while below a depth of about 18 inches it is a dull yellowish brown, very tough, plastic clay. The surface soil, except in areas grading toward the Clyde silty clay loam, is very deficient in organic matter and of compact structure. The granular feel usually noticeable when a dry sample is handled is due to sand grains and very small concretions of ferruginous material. There seems to be a deficiency of lime in the surface soil and upper subsoil, but the lower subsoil, usually below 24 to 30 inches, is highly calcareous.

The Crosby silty clay loam occurs in all sections of the county. Throughout its extent it is intimately associated with the Clyde

silty clay loam, and its elevation is only slightly higher than that of the Clyde areas.

The topography in general is very gently undulating, with occasional low ridges of somewhat stronger relief. As the streams are approached the slopes are generally long and gentle, although occasional steeper gradients occur. Bordering the valleys of the small creeks the declivities are short and sharp, and where of sufficient size such areas were mapped as the Miami silty clay loam.

While nearly all this type has good surface drainage and the structure of the subsoil and substratum admits of relatively free aeration and drainage, the latter would be facilitated and other conditions improved by tile drains. The general extension of the drainage lines in the adjacent areas of Clyde silty clay loam would greatly increase the ability of the Crosby silty clay loam to endure dry weather as well as periods of exceptional rainfall. But few tile drains have been laid in this type.

Areas of small extent in which the silty soil is very loose and floury when dry but inclined to pack after rains are locally referred to as "post-oak" knolls and "beech flats." The subsoil in such places is usually quite compact, and the prevalence of pale-yellowish tints with much gray or bluish-gray mottling indicates slow water movement and ineffective aeration.

In point of extent, as well as of agricultural value, the Crosby silty clay loam is one of the most important types of the county. It is nearly all under cultivation and is used mainly for the production of corn, oats, hay, and wheat. The ordinary yields are possibly a little higher than those of the Miami silty clay loam.

Nearly all the commercial fertilizer used in this county is applied to this type and the Miami silty clay loam. The brands ordinarily used carry from 8 to 10 per cent of phosphoric acid, 1 or 2 per cent of nitrogen, and about 3 or 4 per cent of potash, and the resulting increase in yields seems to be due chiefly to the phosphoric acid. In very few cases, however, has the acid phosphate been used alone. The glacial material of which the Crosby soils are practically the surface expression is rich in potash. That light applications of this element prove beneficial to wheat is due in many instances to the unfavorable physical condition of the soil at the time of seeding. This is probably the reason that such fertilization is not considered necessary on the Clyde soils. Their higher percentage of organic matter, crumbly structure, and more equable moisture content favor an increase in the availability of the mineral elements.

Under the usual methods of handling the Crosby silty clay loam the content of organic matter is too low to render the use of raw rock phosphate advisable.

The present price of this type ranges from \$125 to \$150 an acre.

Since several varieties of clover, including the red, mammoth, alsike, and small white, are easily grown on this soil, the maintenance of organic matter and increase of nitrogen by this familiar means is chiefly a question of soil management. The lack of lime in the surface and its abundance at a comparatively slight depth suggests efficient cultural methods, tile drainage, and frequent changes to clover or deeper rooted leguminous crops rather than the direct application of crushed limestone. The latter may be advisable in some instances, but until such material becomes available at a very low price its general use would not be profitable.

In secs. 16 and 17, T. 25 N., and R. 10 E. (Jackson Township), a very heavy variation of the Crosby silty clay loam occurs. The surface soil is a light brownish gray silty clay loam, somewhat granular, and inclined to crack at the surface on drying. The subsoil is heavier than typical, and in the lower part is usually a stiff, drab or mottled brown and drab, clay.

The topography is nearly level and the type lies slightly lower than the adjoining Miami soils.

Results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Crosby silty clay loam are given in the following table:

Mechanical analyses of Crosby silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
282201.....	Soil.....	0.4	1.8	0.9	3.4	8.0	68.7	16.8
282202.....	Subsoil.....	.1	.6	.4	1.8	8.3	62.6	26.1
282203.....	Lower subsoil...	.1	.3	.2	2.5	9.6	56.1	31.1

CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam consists of a black, granular silty clay loam or silty clay, changing at a depth of 6 to 8 inches to a drab silty clay of less friable structure. This is generally underlain at a depth of 15 to 20 inches by a smooth, somewhat tenacious, light-colored clay, slightly mottled with yellowish-brown iron stains. Underlying most of the type is a substratum of the brownish till which characterizes all the upland soils, but in the vicinity of drainage courses a bed of gravel usually occurs at a depth of a few feet. The surface soil has a high content of organic matter, consisting mostly of old carbonaceous material, which imparts a fine physical structure to what would otherwise be a heavy soil, strongly inclined to become compact with continued tillage. The content of organic matter is usually highest in the surface soil of the largest areas and of those

that form the rather ill defined valleys of small streams. Small areas usually include much gray silty material having only a moderately high percentage of organic matter. According to the litmus-paper test, the upper half of the 3-foot section generally is neutral, while the lower half is calcareous, though not to such a degree as the lower subsoil of the Miami silty clay loam. There seems to be a more equable distribution of the lime throughout the Clyde material than in the Miami and Crosby soils.

The Clyde silty clay loam owes its origin chiefly to obstructed drainage and is confined mainly to depressions and poorly drained flats. It is found in all parts of the county. The topography is level to gently undulating. The natural deficiency in drainage has been remedied by the construction of innumerable mains and the installation of thousands of rods of tile drains. The average level of the ground water, formerly high, which usually is indicated by the depth at which the light-colored clay occurs, has been permanently lowered, although there is much local variation in this respect. In the smaller areas on the uplands the water table may be somewhat nearer the surface than on the adjoining higher lands, but the difference is seldom of importance agriculturally. In the larger areas the average ground-water level is usually much higher. Wherever gravel is found at shallow depths the permanent water table may be within 1 or 2 yards of the surface, or practically at the same level as water in the near-by ditches. The structure of the subsoil admits of good capillarity between these underground supplies and the surface soil. In many instances the drains lack the capacity for as prompt removal of excess surface water as is necessary in very wet seasons. This was apparent in 1915, when the crops in many low places were destroyed by ponded water.

A variation of this type having a black, waxy subsoil is encountered in many of the larger areas, but fortunately is limited to small spots, the largest of which are only a few acres in extent. In the southwestern part of the county this variation is of more common occurrence than in the northern townships. It is locally termed "gumbo" and "blackjack," but hardly warrants such designations. The condition is due to a high percentage of clay particles in the subsoil.

On the lower courses of Eightmile Creek, Rock Creek, and several of the other small streams the type contains a larger proportion of sand and some scattered pebbles, and is somewhat coarser textured and more easily tilled than in other places.

The greater part of this type is in cultivation, the remainder being in woodlots and bluegrass pastures. Practically all crops requiring a soil rich in nitrogen and high in available moisture do well on the Clyde silty clay loam. The soil is especially well suited to corn and

is used very largely in its production. A yield of 100 bushels per acre has been obtained under ordinary field conditions, though the average yield is between 60 and 70 bushels. Wheat and oats make good yields, but in seasons of excessive rainfall harvesting may be difficult on account of a rank growth of straw and the softness of the ground. Timothy and clover seldom fail to make a uniformly good stand, and the growth is heavier than on the light-colored soils. Alfalfa does well wherever grown on this type, but those areas underlain by water and having a gravel substratum at a depth of a few feet furnish ideal conditions for this plant. Such minor crops as soy beans, potatoes, and tomatoes make very satisfactory yields where good culture is given, and the type is preferred for such crops.

As a rule grains and vegetables produced on this type are of somewhat poorer quality than those grown on the light-colored soils. Usually the ripening period is somewhat delayed, and in the case of corn this sometimes involves considerable risk from frost. On the other hand, where drainage is good and other conditions similar, the soil warms up earlier in the spring than the light-gray soils.

No commercial fertilizer is used on the Clyde silty clay loam except in the case of small patches planted to truck crops, and of the small areas included with the Miami silty clay loam where separate treatment is impracticable. Little or no stable manure is used, the limited supply available on most farms being applied exclusively to the higher lying soils.

There are occasional small areas, rarely more than a fraction of an acre in extent, where wheat and oats fail to mature regardless of cultural methods and seasonal conditions. A careful examination of several such spots failed to reveal any abnormal physical condition sufficient to account for the trouble. No injury to other crops is ever apparent, and corn does well in such places. This latter fact is somewhat remarkable, for on the Clyde soils and associated Muck lands in other sections of the State there are similar spots where the corn plants turn yellow and suffer from root rot to such an extent that little if any matured corn is obtained without heavy applications of barnyard manure or the use of potash salts.

Where the content of organic matter is exceptionally high the soil endures careless handling with far less injury than in those places that are not so rich in organic matter. In many fields that have been cultivated 30 or 40 years the effect of a decreasing organic-matter content is indicated by the tendency of the soil to become cloddy and to respond less satisfactorily to tillage than formerly. This condition becomes more pronounced as the black carbonaceous material decreases, for it is chiefly the latter that imparts the crumbly condition to the surface soil and the checked or granular structure to the upper subsoil. The proportion of clay in these zones is about

30 and 35 per cent, respectively, sufficient to make a very heavy, adhesive soil were it not for the ameliorating influence of the included organic matter. The conservation of this soil constituent is quite as important as, although of less immediate interest than, its maintenance in the light-colored soils by plowing under clover crops.

The tillage conditions are invariably improved by fall plowing, especially in those areas that have the stiff, waxy subsurface. While the frequent alterations of freezing and thawing increase the friability of the surface soil, some loss of the finest soil constituents, both mineral and organic, by surface wash, may result unless a cover crop of some kind is grown.

The ample supply of lime in the subsoil is sufficient for all crops under reasonable conditions of tillage.

The present price of farm land consisting chiefly of this type ranges from about \$150 to \$175 an acre.

Average results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type follow:

Mechanical analyses of Clyde silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
282207, 282210	Soil.....	0.5	1.4	1.3	7.4	7.9	50.9	30.4
282208, 282211	Subsoil.....	.5	1.3	1.3	6.9	8.2	47.8	34.1
282209, 282212	Lower subsoil..	.6	1.7	1.3	7.0	7.4	48.1	33.9

The following samples contained more than one-half of 1 per cent calcium carbonate (CaCO_3): No. 282209, 1.13 per cent; No. 282211, 0.86 per cent.

BELLEFONTAINE LOAM.

The surface soil of the Bellefontaine loam to a depth of 12 to 15 inches is a brown to reddish-brown loam or sandy loam. There is considerable textural variation, and as a rule the more sandy areas have a distinctly brown color and carry more stony material than the lighter colored silty areas. The upper subsoil is usually a brownish loam or clay loam, containing enough coarse sand to give it a gritty feel. The proportion of sand and gravel increases with depth, and the lower part of the 3-foot section is generally a dark reddish brown, sticky clay, with much coarse material ranging from sand to small stones. The substratum consists of loose sand and gravel.

This type is found near the Salamonie and Wabash Rivers and Rock Creek. The small areas near the Salamonie River consist of low ridges of such irregular shape and hummocky topography as to leave no doubt of their morainic character. Those near the Wabash River and on the lower course of Rock Creek are not so clearly differentiated from the surrounding uplands.

Owing to the presence of the gravel at slight depths, a part of the type is inclined to be droughty, but in most instances the depth of loam is sufficient to retain enough moisture to carry crops to maturity.

All the areas of this type are in cultivation. Wheat and clover do well in most years, but corn and oats give best returns in seasons of liberal rainfall.

FOX LOAM.

The surface soil of the Fox loam is a friable loam to silt loam, with a variable proportion of coarse sand and pebbles. The color of the silty soil is gray to brown, while that of the more sandy material is a pronounced brown. In all instances the content of organic matter is low.

No very definite line can be drawn between the soil and subsoil, but at a depth of 10 to 15 inches the latter is usually a stiff clay loam, changing with increase of depth to a dark reddish brown gravelly clay in which the coarse material may be so abundant that it can not be penetrated with a soil auger. In such cases the substratum consists of irregularly stratified sand and gravel.

Where the surface soil is a gray silty loam the upper subsoil is generally a compact, yellowish silty clay loam, and the gravel may be several feet below the surface.

The type has an inextensive development in this county. The largest areas occur on the terraces of the Wabash River, but none of the latter include more than 150 acres. Their elevation above the adjacent bottom lands ranges from 10 to 25 feet, and their surface configuration varies from level to gently undulating. The area near Markle is a gently sloping belt of sandy land between the low hills to the south and the narrow river bottom on the north. The other small areas in this locality, with respect to both soil and physiographic position, are rather broad transitions from the upland to the bottom lands. The areas on lower Eightmile Creek are bench lands, rising 15 to 20 feet above the stream. The developments elsewhere are gravelly deposits with a variable depth of sandy loam and loam. The areas on Rock Creek, some of which are too small to be mapped, have a soil resembling the lighter variations of the Miami silty clay loam. The small areas near the Salamonie River are essentially gravel deposits on the outer side of curves. The soil is a brown loam to sandy loam and generally droughty.

All these areas are in cultivation and good yields of corn, clover, oats, and wheat are usually obtained. Wheat does exceptionally well on the heavier areas. The sandy areas with loose gravel at a depth of 2 or 3 feet are, of course, susceptible to dry weather, but these constitute but a small proportion of the type.

All this type may be worked sooner after rains than the adjoining upland soils. The soil is acid and the subsoil does not usually contain much lime, although a large percentage of the underlying gravelly material is limestone.

GENESEE SILT LOAM.

The Genesee silt loam as developed in the Wabash Valley consists of a brown silt loam, 12 to 15 inches deep, underlain by a dark-brown and gray mottled silt loam to silty clay loam, which at a depth of 2 or 3 feet usually grades into coarse sandy loam. There is considerable variation in the texture of the surface soil, chiefly with respect to the proportion of sand. In many places it is a sandy loam of slightly reddish brown color. In such places the subsoil is generally a brown sandy loam underlain by gravel. In the slightly depressed areas along the foot of the hillsides the soil is a dark-colored silt loam with a rather heavy subsoil. Between Murray and Markle this heavy alluvium is of quite common occurrence and the underlying limestone is within a few feet of the surface at some points. Also near Barbers Mill, on Rock Creek, a dark-colored, heavy soil occurs, and near the village the limestone is frequently found within 3 feet of the surface.

In the Salamonie Valley the type is generally heavier and darker colored than along the Wabash River. The slightly elevated parts of the alluvial deposits are somewhat sandy, but in the depressions the soil is a rather crumbly silt loam or silty clay loam containing considerable organic matter.

The type as developed along the lower courses of the small streams is a dark silty loam to silty clay loam, in many places practically identical with the lighter portions of the Clyde silty clay loam.

All the type is subject to overflow, but the floods in the river valleys usually occur early in the season. In 1915 exceptionally high waters in July and August destroyed the crops on the lower parts of the bottom lands of the Salamonie River, Rock Creek, and other small streams. A large proportion of the Genesee silt loam along the Wabash lies so high that the injury to crops was not great. Such destructive midsummer floods had not occurred since 1875.

Nearly all the type is cleared. Oats and clover do well, but most of the land is devoted to corn, with rather irregular alternations to small grain or grass crops. In favorable seasons yields of 50 to 60 bushels per acre are obtained on the sandy areas, while the silty areas often produce higher yields.

MUCK.

The largest area of Muck in Wells County lies along upper Eight-mile Creek, in Jefferson Township. It forms a nearly continuous

border generally less than one-fourth mile wide, on each side of the channel from the east boundary of the county to near Ossian.

In this area the Muck consists of black, finely divided vegetal remains without much earthy material in the surface portion, except where silt has been deposited by overflow water from the streams or washed from the higher lands. In places there is considerable rotten and partially carbonized wood, and where the accumulations are deepest, as in the section east of Tocsin, the lower part of the material is somewhat peaty. The depth seldom exceeds 3 or 4 feet, and the average is much less. There has been much settling of this area in recent years, and in secs. 31 and 32, T. 28, R. 13 E., the surface material to a depth of several feet was burned about 16 years ago. Farther down the stream smaller areas have been similarly reduced in depth at various times. The substratum, so far as observations could be made, seems to consist throughout of a stiff, light-colored clay, rich in lime.

The channel of Eightmile Creek has been straightened and deepened, so that it affords a good outlet for the numerous ditches and tile drains by which the Muck and adjoining Clyde silty clay loam have been reclaimed.

The next largest area of Muck is that southwest of Bluffton, on Prairie Ditch. It was originally a marsh, but is now well drained. The material in this area is generally from 1 to 3 feet in depth and is underlain by clay. In places the latter is very calcareous a little below its contact with the overlying vegetable remains.

The small areas in other parts of the county are essentially the same as that just described. The soil is of variable depth, usually grading from a few inches of silty muck at the margin to nearly clear carbonaceous material at the center, which may have a depth of several feet.

The surface layer of all the Muck areas is acid, according to tests with litmus paper.

Nearly all the Muck is under cultivation, with corn as the main crop. Corn does well, although there is liability to injury by overflows and late frosts. The quality of the grain is not so good, especially in wet seasons, as that on the uplands.

On Muck and Peat soils in other areas corn usually is more or less affected by some disease that causes the roots to rot and the foliage to turn yellow, but in this county such injury has not occurred to any appreciable extent. Where several feet of the original surface has been burned it is possible that the potash thus released acts as an amendment similar to the muriate or sulphate of potash that is often applied to mucky soils as a corrective of this trouble, but this does not

explain the fact that all the Muck in Wells County is singularly free from this cause of injury to corn.¹

Red and alsike clovers usually make a rank growth, but the lower part of the stems often rots and the quality of hay is thus injured.

Oats are not usually sown in Muck, for if the season is wet it is almost impossible to harvest them satisfactorily. Wheat is less inclined to lodge, and on the shallower areas usually does well in dry years.

Excellent yields of rye and barley have been reported, and the ordinary yields of the limited acreages grown are higher than on any other soils in the county.

In a few instances alfalfa has been successfully grown on the shallower areas of Muck. Considering the abundance of nitrogen, the calcareous nature of the clay subsoil, and the high average level of the water table in well-drained places, it seems that alfalfa should thrive on the shallower areas of this type. On the deeper areas the looseness of the soil and the somewhat uncertain moisture conditions might prove unsuitable for this crop.

In some places it is probable that the water supply could be controlled by damming the ditches or installing some form of pumping plant and a small acreage thus rendered highly suitable for celery, onions, and cabbage.

The area shown as Muck in secs. 22 and 23, Jackson Township, is really a good development of Peat, but it is too small to show as a separate type. It is the bed of a small lake that was drained a few years ago, and also forms the margin of a rather deep pond near-by. The soil consists chiefly of brown, fibrous material in which the partially decomposed remains of aquatic plants are still abundant. Excepting the margin, which is in part Muck and also includes a few acres of black sandy loam, this area has very little agricultural value.

MEADOW.

Meadow represents the variable soil conditions encountered in the narrow, troughlike valleys of the larger creeks. It consists of alluvial material, chiefly silt, but there is more or less sand, especially near the channels, and the soil varies from sandy loam to heavy silt loam, the latter predominating. As a rule the surface is quite uneven, there being sections of abandoned channels and ill-drained spots at the foot of the slopes, so that cultivation is inconvenient. Most of such land is used only for pastures.

The low strips of alluvium along the Salamonie River that were mapped as Meadow are so frequently overflowed that very little of

¹ See description of Muck in Soil Survey of Boone County, Ind. Field Operations of the Bureau of Soils, 1912.

their area is tillable. In most instances they are covered with trees, underbrush, and weeds. On the Wabash River there is very little alluvium that can be classed with Meadow.

SUMMARY.

Wells County is situated in the northeastern part of Indiana and embraces an area of 365 square miles, or 233,600 acres. The greater part of the surface is a somewhat uneven plain having an elevation of about 850 feet above sea level. The topography is undulating to rolling. Practically all the surface is tillable, with the exception of the steep slopes that bound the stream valleys and the few very small areas of Muck and Meadow.

The rivers and larger creeks of the county follow a general course from southeast to northwest, but many of the minor streams flow from southwest to northeast.

The 1910 census reports the population of the county as 22,418, of which 77.8 per cent is classed as rural. The population of Bluffton, the county seat and largest town, was 4,987, and that of Ossian, the next largest town, 661. The greater part of the county is well served by steam and electric railroads, and the public roads and market facilities are good. Almost every farmhouse has telephone and rural free delivery of mail service.

The climate of the county is comparatively uniform. The mean annual temperature at Bluffton is 50° F., and the mean annual precipitation is 36.94 inches, the greater part of which falls during the spring and summer months. There is a normal growing season of 148 days.

Corn, wheat, oats, and clover are the principal crops grown in Wells County. Alfalfa, soy beans, and sugar beets are grown to some extent. Wheat and sugar beets are about the only strictly sale crops. Oats is chiefly a sale crop, although much of the grain is fed on the farms. By far the larger part of the corn is also fed at home or sold in the county. Hog raising is the chief animal industry and is very important. In 1909 there were 65,342 hogs sold or slaughtered, or an average of about 36 head per farm. Comparatively few cattle are fattened and dairying has not been extensively developed.

In 1900 there were 2,884 farms in the county and in 1910 the number had decreased to 2,655. The average size of farms is 85.2 acres. The price of farm land ranges from \$100 to \$200 an acre.

Exclusive of the miscellaneous classifications, Muck and Meadow, the soils of the county are grouped in six series, in each of which one type is mapped. Three types, the Miami, Crosby, and Clyde silty clay loams, constitute the greater part of the area surveyed.

The Miami silty clay loam is a well-drained, light-colored type, well suited to general farming, but has not the high productive capacity that characterizes the Clyde silty clay loam.

The Crosby silty clay loam also is a light-colored type having a flat to gently undulating topography. It is less perfectly drained than the Miami silty clay loam. Corn, oats, and hay are the important crops.

The Clyde silty clay loam is a black soil, very well suited to corn and clover.

The Bellefontaine loam is a brown upland soil underlain by gravel. The Fox loam is a similar type occurring on the terraces of the larger streams. Both are inextensively developed. They are used for the general crops and give good yields.

The Genesee silt loam includes all the safely tillable alluvial soil. Corn is the chief crop and usually heavy yields are obtained.

Meadow embraces alluvial deposits of low agricultural value on account of liability to frequent overflows.

The several areas of Muck mapped in the county are artificially drained and devoted chiefly to corn, clover, and timothy.



[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

"That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture."

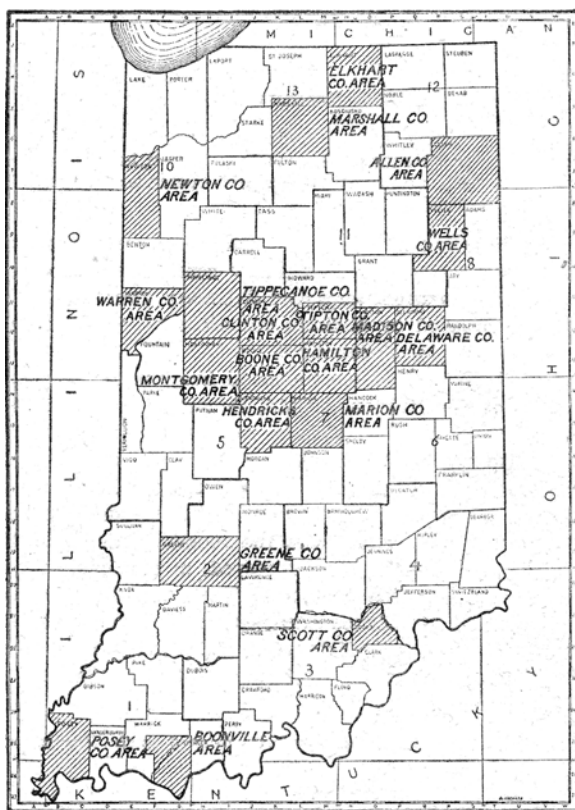
Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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Areas surveyed in Indiana.

